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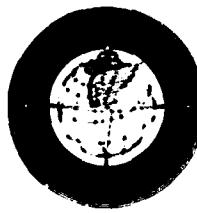
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# OBSTRUCTION MARKING and LIGHTING

Revised September 1962



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FEDERAL AVIATION AGENCY

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## **INTRODUCTION**

The Administrator of the Federal Aviation Agency has the statutory responsibility of promoting safety in air commerce. In the light of this responsibility, the Federal Aviation Agency is vitally concerned with any object which may be a hazard to the safe operation of aircraft.

The standards for marking and lighting obstructions prescribed in this publication are designed to provide the most effective means of indicating the presence of obstructions to pilots. In many instances the obstruction may be so located in reference to other objects or the contour of the ground, that the specific standard need be applied to only a portion of it. Similarly, the obstruction may be so removed from the general flow of air traffic or may be so conspicuous by its shape, size, or color that obstruction marking would serve no useful purpose and would be unnecessary. Furthermore, the obstruction may present such a hazard that lighting should be provided similar to that for an obstruction of greater height or size. Portions of obstructions that are shielded by surrounding objects need not be marked or lighted, but the surrounding objects should be marked and lighted.

Because of the many influencing elements, the Federal Aviation Agency may recommend modification of the obstruction marking and lighting standards described herein when aeronautical study has indicated that marking and lighting of an obstruction in accordance with the recommended modification would provide suitable protection for air commerce.

Objects or portions thereof, either temporary or permanent, which exceed the criteria of hazards to air navigation set forth in Part 77 of the Federal Aviation Regulations (14 CFR 77) or the criteria of obstructions set forth in Technical Standard Order of the Administrator No. TSO-N18 and all objects or portions thereof, either temporary or permanent, greater than 170 feet in overall height above site level should be marked and lighted in accordance with the applicable standards herein, unless an FAA aeronautical study determines that the absence of such marking and/or lighting will not impair safety in air navigation.

The specifications for obstruction marking and lighting antenna structures, contained in Subpart C of Part 17 of the Federal Communications Commission's Rules and Regulations, are identical with the standards described herein for marking obstructions with bands of aviation surface orange and white and for lighting obstructions in accordance with the "A" specifications.

This publication supersedes the November 1, 1953 edition of *Obstruction Marking and Lighting* published by the Civil Aeronautics Administration.

## **SECTION I—MARKING**

The purpose of marking an obstruction which presents a hazard to air commerce is to warn airmen during the hours of daylight of the presence of such an obstruction. To accomplish this objective, it may be necessary to color such an obstruction so that it will be visible from aircraft at any normal angle of approach, or to indicate the general definition and location of the obstruction by use of suitable markers or flags.

When the upper part of only a portion of a building or similar extensive obstruction projects above an airport imaginary surface, as described in Part 77 of the Federal Aviation Regulations, or in Technical Standard Order TSO-N18, that portion only need be obstruction marked and the point or edge of it highest in relation to the airport imaginary surface should be regarded as the "top of the obstruction." In certain cases, however, such as when the airport imaginary surface concerned is an approach or transition surface (i.e., sloping), this point or edge highest in relation to the airport referenced surface may not be the highest point or edge above a horizontal plane passing through the base of the object. In such cases, those portions of the object, the upper parts of which are higher above a horizontal plane passing through the base of the object than the upper part considered as the "top of the obstruction," should also be obstruction marked.

### **Marking of Vehicles**

Vehicles customarily used on landing areas should be marked in accordance with the provisions of Technical Standard Order TSO-N4, Army-Navy-Civil Uniform Requirements for the Marking of Vehicles Used on Landing Areas.

### **Marking of Natural and Manmade Obstructions**

**Markers.** Markers should be used to mark obstructions when it has been determined that it is impracticable to mark such obstructions by use of surface colors, or it has been determined that markers should be used to provide protection for air commerce in addition to that provided by the application of aviation surface orange and white colors.

*General Application.* Markers used to mark obstructions should be displayed on or adjacent to the obstructions in conspicuous positions so as to retain the general definition of the obstruction and should be recognizable in clear air from a distance of at least 1,000 feet in all directions from which an aircraft is likely to approach the obstruction.

The shape of such markers should be distinctive to the extent necessary to insure that they are not mistaken for markers employed to convey other information, and they should be such that the hazard presented by the obstruction they mark is not increased.

*Overhead Wires.* Markers displayed on overhead wires should be spherical in shape with a diameter of not less than 20 inches, or may be of another shape, provided the projection of such type of marker on any vertical surface, normal to each direction from which an aircraft is likely to approach the obstruction, will be not less than that presented by the spherical-type marker described above.

At least one such marker should be displayed for each 150 feet, or fraction thereof, of the overall length of the overhead line. These markers should be placed at equal intervals not more than 150 feet apart with the top of each marker not below the level of the highest wire at the point marked, and should be colored as specified under the marking of obstructions by "colors." The distance between markers on overhead wires located more than 15,000 feet from the reference point of any landing area may be increased to a distance of not more than 600 feet.

*Flags.* Flags may be used to mark obstructions when it has been determined that marking such obstructions by coloring or by markers is technically impracticable.

The flags should be displayed around or on top of the obstruction or around its highest edge and should not increase the hazard presented by the obstruction they mark. When flags are used to mark extensive obstructions or groups of closely spaced obstructions, they should be displayed at approximately 50-foot intervals.

The flags should be rectangular in shape and have stiffeners to keep them from drooping in calm or light wind. The flag stakes should be of such strength and height that they will support the flags free of the ground, vegetation, or nearby surfaces.

The flags should be in accordance with one of the following patterns:

- (a) Solid-color aviation surface orange not less than 2 feet on a side.
- (b) Two triangular sections, one of aviation surface orange and the other of aviation surface white, combined to form a rectangle not less than 2 feet on a side.
- (c) A checkerboard pattern of aviation surface orange and aviation surface white squares, each 1 foot plus or minus 10 percent on a side, combined to form a rectangle not less than 3 feet on a side.

**Colors.** Maximum visibility of obstructions by contrast in colors can best be obtained by the use of aviation surface orange and white. Paints and enamels of these colors have been developed for use by Government agencies and private industry in marking obstructions to air navigation. In marking, either the aviation surface orange paint or enamel may be used as preferred.

The painted surfaces of obstructions should be cleaned or repainted as often as necessary to maintain good visibility.

If the smooth surface of the paint on the ladders, decks, and walkways of certain types of steel towers and similar structures presents a potential danger to maintenance personnel, such surfaces need not be painted. However, the omission of paint should be restricted to actual surfaces the painting of which will present a hazard to maintenance personnel, and care should be taken that the overall marking effect of the painting is not reduced.

**Solid.** Obstructions the projection of which on any vertical plane has both dimensions less than 5 feet should be colored aviation surface orange.

**Bands.** Towers, poles, smokestacks, and similar obstructions, as well as buildings of certain shape and dimensions, having essentially unbroken surfaces the projection of which on any vertical plane is 5 feet or more in one dimension and is less than 15 feet in the other dimension, and any skeleton- or smokestack-type obstruction having both dimensions 5 feet or more, should be colored to show alternate bands of aviation surface orange and white.

The bands should be perpendicular to the major axis of the obstruction, with the band at each end colored aviation surface orange. The widths of the bands should be equal and the width of each band should be approximately one-seventh of the length of the major axis of the obstruction, provided that each band shall have a width of not more than 40 feet nor less than 1½ feet. If it is technically impracticable to color the roof of a building to show alternate bands of aviation surface orange and white, such roof may be colored aviation surface orange.

**Checkerboard Pattern.** Water towers, grain elevators, gas holders, and similar obstructions, as well as buildings of certain shape and dimensions, having essentially unbroken surfaces the projection of which on any vertical plane is 15 feet or more in both dimensions, should have their top and vertical surfaces colored to show a checkerboard pattern of alternate rectangles of aviation surface orange and white. If it is technically impracticable to color the roof of a building to show alternate rectangles of aviation surface orange and white, such roof may be colored aviation surface orange.

The sides of the rectangles should measure not less than 5 feet nor more than 20 feet. The rectangles at the corners of surfaces should be colored aviation surface orange.

If a part of a water tower, gas holder, building, or similar obstruction consists of a skeleton-type construction, that portion of the obstruction should be colored with alternate bands of aviation surface orange and white as specified for towers, poles, smokestacks, and similar obstructions. In this case, if the portion of the obstruction, which is to be colored to show a checkerboard pattern of alternate rectangles of aviation surface orange and white, has any surfaces the projection of which on any vertical plane is less than 15 feet in either dimension, the alternate rectangles of aviation surface orange and white may have dimensions of less than 5 feet on a side, provided their dimensions remain as close as is practicable to the minimum 5 feet specified for coloring by the checkerboard pattern.

If the size and shape of water towers, grain elevators, gas holders, and similar obstructions come within the dimensions set forth under the specification for coloring by bands, or if their type of construction does not permit coloring by the checkerboard pattern as herein-before described, then such obstructions should be colored by bands as specified for towers, poles, smokestacks, and similar obstructions. Where this method of coloring is employed, the top aviation surface orange band should be continued from the vertical surface so as to cover the entire top of the obstruction.

If a part, or all, of certain obstructions such as water towers and gas holders of spherical shape does not permit the exact application of the checkerboard pattern of coloring, then the shape of the alternate rectangles of aviation surface orange and white covering the spherical shape may be modified to fit the particular shape of the structural surface, provided the dimensions of these modified rectangles remain to the extent practicable within the dimensional limits set forth in the specifications for coloring by the checkerboard pattern.

If certain obstructions such as gas holders and grain elevators are of such large size that the application of the checkerboard pattern of coloring to the complete outer surface of the structure would be impracticable, the application of the checkerboard pattern of coloring may be limited to the upper one-third of the structure, provided aeronautical study indicates that the modified marking will provide adequate protection for air navigation.

**Special Day Lighting.** The display of flashing or steady burning lights on an obstruction during daylight hours, for the purpose of warning airmen of the presence of such an obstruction, may be prescribed under certain conditions.

The foregoing day lighting is intended to provide protection in addition to that provided by the applicable marking standard hereinbefore described.

**Marking of Hazard Areas.** In an area where towers, poles, and similar obstructions are so grouped as to present a common hazard to air commerce; where the hazard of a particular obstruction is increased by guy wires or other appurtenances, or where an invisible hazard to aircraft in flight exists, the outer limits of the area should be marked by four (4) or more symbols consisting of the letters "HAZ," located so that at least one symbol will be visible from aircraft at any normal angle of approach. In the case of a structural hazard secured by guy wires, the marking symbols should be located immediately beyond the ground connection of the outer guy wires.

The letters of such symbols should be installed in a manner to be legible in clear air at an altitude of 3,000 feet at a distance of 2 miles. Moreover, the symbols should consist of uniform block letters having a height of at least 30 feet and a width equal to two-thirds of the height. The width of each stroke should be approximately one-seventh of the height of the letters. In addition, the letters should be colored aviation surface orange.

The symbols should be cleaned and repainted as often as necessary to maintain good visibility. If the strokes of the letters are constructed of wood or metal panels, such construction should be designed to prevent an accumulation of snow. The foregoing marking is intended to provide additional protection for air commerce and does not lessen the need for marking the prominent obstruction, or obstructions, located within the area.

## **SECTION II—LIGHTING**

The purpose of lighting an obstruction which presents a hazard to air commerce is to warn airmen during the hours of darkness and during periods of limited daytime light intensity of the presence of such an obstruction. To accomplish this objective, it is necessary to provide adequate lighting on the obstruction in a manner which assures visibility of such lighting from aircraft at any normal angle of approach. In determining the proper amount of obstruction lighting to adequately mark an obstruction, the mean elevation of the top of the buildings in closely built-up areas may be used as the equivalent of the ground level.

The top light, or lights, displayed on an obstruction should be installed so as to mark the points or edges of the obstruction highest in relation to an airport imaginary surface, as described in Part 77 of the Federal Aviation Regulations or in Technical Standard Order TSO-N18, except that when no airport imaginary surface is involved, such top light, or lights, should be installed on the points or edges of the obstruction highest in relation to the ground, or water if so situated. If two or more edges of an extended obstruction located near a landing area are of the same height, the edge nearest the landing area should be lighted.

When the upper part of only a portion of a building or similar extensive object projects above an airport imaginary surface, as described in Part 77 of the Federal Aviation Regulations or in Technical Standard Order TSO-N18, that portion only need be obstruction lighted and the point or edge of it highest in relation to the airport imaginary surface should be regarded as the "top of the obstruction." In certain cases, however, such as when the airport imaginary surface concerned is an approach or transition surface (i.e., sloping), this point or edge highest in relation to the airport imaginary surface may not be the highest above a horizontal plane passing through the base of the object. In such cases, additional obstruction lights should be placed on the highest part of the object as well as on the point or edge highest in relation to the airport imaginary surface.

If a light, or lights, which is installed on an obstruction is shielded in any direction by an adjacent object, additional lights should be mounted on that object in such a way as to retain the general definition

of the obstruction, the shielded light, or lights, being omitted if it does not contribute to the definition of the obstruction.

Obstruction lights and hazard beacons should be operated at all times when the center of the sun's disk is 6° or more below the horizon and during periods of restricted visibility. They may also be operated at such other times as considered desirable. For the purpose of this standard, the term "sunset to sunrise" shall be generally regarded as that period when the center of the sun's disk is 6° or more below the horizon.

**Temporary Warning Lights.** When an obstruction to air navigation is presented during construction of a structure at least two lights, each light consisting of a lamp of at least 100 watts enclosed in an aviation red obstruction light globe, should be installed at the uppermost point of the structure. In addition, as the height of the structure exceeds each level at which permanent obstruction lights will be required, two similar lights should be installed at each such level. These temporary warning lights should be displayed nightly from sunset to sunrise until the permanent obstruction lights have been installed and placed in operation, and should be positioned so as to insure unobstructed visibility of at least one of the lights at each level from aircraft at any normal angle of approach. It will be permissible, in the event it is more practicable, to install and operate the permanent obstruction lighting fixtures at each required level, in lieu of the above temporary warning lights, as each such level is exceeded in height during construction.

### **Operation of Obstruction Lighting**

**Light-Sensitive Control Device.** The operation of obstruction lighting installed on obstructions of an overall height greater than 150 feet above ground, or water if so situated, should be controlled by a light-sensitive control device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot-candles and turned off at a north sky light intensity level of about 58 foot-candles, or should be continuous.

Under normal conditions, where no special means of controlling obstruction lighting has been recommended, either a light-sensitive control device or an astronomic dial clock and time switch may be used to control the obstruction lighting in lieu of manual control.

**Inspection of Obstruction Lighting.** Obstruction lighting should be visually observed at least once each 24 hours, or checked by observing an automatic and properly maintained indicator designed to register any failure of such lights, to insure that all such lights are functioning properly as required. In the event the obstruction lighting is not readily accessible for the above observation at least once each 24

hours, an automatic alarm system designed to detect any failure of such lights may be installed to replace the normally required visual inspection. The Federal Aviation Agency will not object to excluding the side or intermediate obstruction lights on an obstruction from the alarm circuit, provided the signaling device will indicate malfunctioning of all flashing and rotating beacons regardless of their position on the obstruction, and of all top lights; and that all obstruction lights mounted on the obstruction are visually inspected at least once every 2 weeks, with all lamps being replaced at regular intervals after being lighted the equivalent of not more than 75 percent of their normal life expectancy.

**Notification of Light Failure.** Any observed or otherwise known extinguishment or improper functioning of a rotating or flashing beacon light, regardless of its position on a natural or manmade obstruction, which will last more than 30 minutes, and any observed or otherwise known extinguishment or improper functioning of a steady burning obstruction light, installed at the top or near top of any natural or manmade obstruction, which will last more than 30 minutes, should be immediately reported. Such reports should be made by telephone or telegraph to the nearest flight service station or office of Federal Aviation Agency and should set forth the condition of the light, or lights, the circumstance which caused the failure and the probable date that normal operation will be resumed. Further notification by telephone or telegraph should be given immediately upon resumption of normal operation by the light, or lights.

Any extinguishment or improper functioning of a steady burning side or intermediate light, or lights, installed on a natural or manmade obstruction should be corrected as soon as possible, but notification of such extinguishment or improper functioning is not necessary.

**Flashing Frequency of Lights.** A rotating beacon should produce a flash not less than 12 times per minute nor more than 15 times per minute. A flashing beacon should be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 1 flashes per minute with a period of darkness equal to approximately one-half the luminous period, except that the frequency of flashes of an obstruction beacon mounted on an obstruction located within 15,000 feet of the reference point of a landing area should be not less than 20 per minute.

A flashing beacon may flash an International Morse Code Signal for purposes of identification, provided the code characteristic does not consist of more than two letters, the proper aviation color characteristic is retained, and the luminous output of the beacon is not affected in such a manner as to reduce the beacon's effectiveness in performing the service for which it was originally installed. The duration of the illumination and eclipse periods is important to insure

a maximum light intensity. Therefore, an effort should be made to have code assignments adjusted, insofar as possible, to the following timing:

Duration of dot.....	0.5 second.
Duration of dash.....	1.5 seconds.
Duration of eclipse.....	0.5 second between dots and dashes of a particular letter.
Duration of eclipse.....	1.5 seconds between letter and repetition of single letter characteristics.
Duration of eclipse.....	2.0 seconds between characteristics which contain two letters.

Each proposal to have a flashing beacon flash an identifying code should be coordinated with the Assistant Administrator having jurisdiction over the functions of the Federal Aviation Agency in the area in which the particular beacon is located.

Approval must be obtained from the Federal Communications Commission for the modification of any obstruction lighting system which comes within the jurisdiction of that agency.

**Flashing of Intermediate Lights.** If the flashing mechanism in obstruction lighting circuits is installed so as to make it necessary for the intermediate lights to flash, the simultaneous flashing of all lights will be permissible.

**Color of Lighting.** The signal emitted by hazard beacons and obstruction lights shall be aviation red in color.

**Intensity of Lighting.** The integral of the time-intensity curve of each flash emitted by a flashing hazard beacon, measured in the direction corresponding to the peak intensity and integrated over a period not exceeding 1.0 second, should be not less than 1,500 candle-seconds of aviation red light.

The integral of the time-intensity curve of each flash emitted by a rotating hazard beacon, measured in the direction corresponding to the peak intensity and integrated over a period not exceeding 0.5 second, should be not less than 7,500 candle-seconds of aviation red light.

The intensity of fixed obstruction lights should be not less than 10 candles of aviation red light.

**Light Distribution.** The vertical and horizontal light distribution of the fixed obstruction lights should meet the requirements specified in the pertinent specifications listed in this publication. The vertical light distribution of the flashing and rotating hazard beacons should be such that the time-intensity integral of the flashes at angles between 1° and 8° above the horizontal is not less than the candle-seconds values specified hereinbefore under "Intensity of Lighting," and the time-intensity integral at angles between 8° and 15° above the horizontal is not less than the product of these candle-seconds values mul-

tiplied by 9 over the square of the numerical value in degrees of the angle above the horizontal.

**Rated Lamp Voltage.** To provide satisfactory output by obstruction lights, the rated voltage of the lamp used should, in each case, correspond to or be within 3 percent higher than the average voltage across the lamp during the normal hours of operation.

**Interference With Railway Signals.** Where obstruction lighting is installed on obstructions which are located along or near railroad rights-of-way and thereby constitutes a potential hazard to the safe operation of railway trains, extreme care should be taken to prevent any possibility of these obstruction lights being mistaken by locomotive engineers for railway signal lights. The appropriate Assistant Administrator of the Federal Aviation Agency is responsible for assuring that such obstruction lighting installations are fully coordinated with all parties concerned and that proper corrective measures are determined and placed in effect. Shielding of the obstruction lights from the view of the locomotive engineers, if practicable, should be considered; the fixed lights on the obstruction may be made to flash; or the lights at the lower levels of the obstruction may be extinguished if their extinguishment does not materially increase the hazard to air navigation caused by the presence of the obstruction.

Approval must be obtained from the Federal Communications Commission for the modification of any obstruction lighting system which comes within the jurisdiction of that agency.

**Obstruction Lighting by Nonstandard Lights.** Obstruction lighting installations may utilize incandescent lamps other than those specified under the recommended lamp equipment, gaseous tubes such as neon tubes, or any method other than the conventional incandescent lamps, provided such lighting installations offer equal or greater light intensity in all angles of azimuth and elevation than that specified for standard obstruction light assemblies, afford equal or greater dependability of operation, and possess the color characteristics prescribed in the following specifications.

## Obstruction Lighting Equipment

**Specifications and Drawings.** The lighting equipment, paint and aviation colors referred to in the standards set forth in this publication should conform with the applicable provisions of the following specifications and their related drawings.

### Rotating Beacons

- (a) Federal Aviation Agency Specification 291  
Beacons, 36-inch, Rotating Double Ended Type
- (b) Federal Aviation Agency Specification 232  
Beacons, 24-inch, Rotating Dome Type

- (c) Military Specification MIL-L-7158  
Lamp Assembly—24-inch Rigid Drum Type Rotating Beacon

**Flashing Code Beacons**

- (a) Federal Aviation Agency Specification 446  
Code Beacons, 300 mm

**Double and Single Obstruction Lights**

- (a) Military Specification MIL-L-7830  
Light, Navigational Boundary and Obstruction Markers  
(b) Federal Aviation Agency Specification L-810  
Specification for Obstruction Light

**Covers for Aeronautical Lights**

- (a) Military Specification MIL-C-7989  
Covers; Light-Transmitting (for Aeronautical Lights)

**Astronomic Dial Clock and Time Switch**

- (a) Federal Aviation Agency Specification 618  
Astronomic Dial Clock and Time Switch

**Aviation Colors**

- (a) Air Force-Navy Aeronautical Specification AN-C-56  
Colors; Aeronautical Lights and Lighting Equipment  
(b) Federal Specification TT-C-595  
Color Guide; Ready Mixed Paint  
(1) Orange No. 12197 (Aviation Surface Orange)  
(2) White No. 17875 (Aviation White)

**Aviation Surface Paint**

- (a) Federal Specification TT-P-59  
Aviation Surface Orange Paint  
(b) Federal Specification TT-E-489  
Aviation Surface Orange Enamel  
(c) Federal Specification TT-P-102  
Outside White Paint

**Air Force-Navy Aeronautical Standard Drawings**

- (a) AN2541  
Globe—Marker Lamp  
(b) AN2547  
Fitting Assembly—Marker Lamp  
(c) AN2563  
Lamp Assembly—Single 24-inch, Rigid, Drum Type Rotating Beacon

## Recommended Lamp Equipment

### MULTIPLE CIRCUITS

Type	Watts	Base	Lamp	Average rated lamp life (hours)	Approximate lumens
Traffic signal.....	100	Med. sc.....	A21/TS	2,000	1,260
Airport lamp.....	100	Med. pfc.....	A21/TS	2,000	1,180
Traffic signal.....	107	Med. sc.....	A21/TS	3,000	1,260
Traffic signal.....	116	Med. sc.....	A21/TS	6,000	1,260
Code beacon.....	500	Mog. pfc.....	PS40	1,000	10,800
Airway beacon.....	500	Med. bip.....	T20	500	9,500
Code beacon.....	620	Mog. pfc.....	PS40	3,000	11,000
Airway beacon.....	1,000	Mog. bip.....	T20	500	20,500
Airway beacon.....	1,200	Mog. bip.....	T20	750	27,500

### SERIES CIRCUIT

Obstruction.....		Med. pfc.....	A21	2,000	1,020
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Copies of Military Specifications and Air Force-Navy Aeronautical Specifications or drawings can be obtained by contacting Commanding General, Air Material Command, Wright Field, Dayton, Ohio, or the Bureau of Naval Weapons, Department of the Navy, Washington 25, D.C. Copies of specifications and information concerning Air Force-Navy Aeronautical Specifications and Federal Specifications can be obtained from the Federal Aviation Agency, Washington 25, D.C.

## **SECTION III—STANDARDS FOR LIGHTING OBSTRUCTIONS TO AIR NAVIGATION**

### **Towers, Poles, and Similar Obstructions**

Towers, poles, and similar obstructions should be lighted in accordance with the following specifications:

**Specification "A-1."** When the particular obstruction is not more than 150 feet in overall height above the ground, or water, if so situated:

There should be installed at the top of the obstruction at least two lights, each light consisting of a lamp of at least 100 watts enclosed in aviation red obstruction light globes. These lights should burn simultaneously, and should be positioned so as to insure unobstructed visibility of at least one of the lights from aircraft at any normal angle of approach.

**Specification "A-2."** When the particular obstruction is more than 150 feet but not more than 300 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each lamp should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons at any normal angle of approach.

At the approximate midpoint of the overall height of the obstruction, there should be installed at least two lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. Each light should be placed on diagonally or diametrically opposite positions of the obstruction and mounted so as to insure unobstructed visibility of at least one light from aircraft at any normal angle of approach.

In case of a triangular or rectangular shaped tower, the lights at the midlevel should be mounted so as to insure unobstructed visibility of at least one light from aircraft at any normal angle of approach, or a light should be installed on each corner of the tower at this level.

**Specification "A-3."** When the particular obstruction is more than 300 feet but not more than 450 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

On levels at approximately two-thirds and one-third of the overall height of the obstruction, there should be installed at least two lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. Each light should be placed on diagonally or diametrically opposite positions of the obstruction and mounted so as to insure unobstructed visibility of at least one light at each level from aircraft at any normal angle of approach.

In case of a triangular or rectangular shaped tower, the lights at the two-thirds and one-third levels should be mounted so as to insure unobstructed visibility of at least one light on each level from aircraft at any normal angle of approach, or a light should be installed on each corner of the obstruction at each level.

**Specification "A-4."** When the particular obstruction is more than 450 feet but not more than 600 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately one-half of the overall height of the obstruction, a similar flashing 300-mm electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event this beacon cannot be installed in a manner to insure unobstructed visibility of it from aircraft at any normal angle of approach, there should be installed two such beacons. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed height.

On levels of approximately three-fourths and one-fourth of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes, should be installed on each outside corner of the obstruction at each level.

**Specification "A-5."** When the particular obstruction is more than 600 feet but not more than 750 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately two-fifths of the overall height of the obstruction, a similar flashing 300-mm electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event this code beacon cannot be installed in a manner to insure unobstructed visibility from aircraft at any normal angle of approach, there should be installed two such beacons at this level. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed height.

On levels at approximately four-fifths, three-fifths, and one-fifth of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes should be installed on each outside corner of the obstruction at each level.

**Specification "A-6."** When the particular obstruction is more than 750 feet but not more than 900 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts.

Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately two-thirds and at approximately one-third of the overall height of the obstruction, a similar flashing 300-mm electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event these electric code beacons cannot be installed in a manner to insure unobstructed visibility from aircraft at any normal angle of approach, there should be installed two such beacons at each level. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed heights.

On levels at approximately five-sixths, one-half, and one-sixth of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes should be installed on each outside corner of the obstruction at each level.

**Specification "A-7."** When the particular obstruction is more than 900 feet but not more than 1,050 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately four-sevenths, and at approximately two-sevenths of the overall height of the obstruction, a similar flashing 300-mm electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event these electric code beacons cannot be installed in a manner to insure unobstructed visibility from aircraft at any normal angle of approach, there should be installed two such beacons at each level. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed heights.

On levels at approximately six-sevenths, five-sevenths, three-sevenths, and one-seventh of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes should be installed on each outside corner of the obstruction at each level.

**Specification "A-8."** When the particular obstruction is more than 1,050 feet but not more than 1,200 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately three-fourths, one-half, and one-fourth of the overall height of the obstruction, a similar flashing 300-mm electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event these electric code beacons cannot be installed in a manner to insure unobstructed visibility from aircraft at any normal angle of approach, there should be installed two such beacons at each level. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed heights.

On levels at approximately seven-eighths, five-eighths, three-eighths, and one-eighth of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes should be installed on each outside corner of the obstruction at each level.

**Specification "A-9."** When the particular obstruction is more than 1,200 feet but not more than 1,350 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately two-thirds, four-ninths, and two-ninths of the overall height of the obstruction, a similar flashing 300-mm electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event these electric code beacons cannot be installed in a manner to insure unobstructed visibility from aircraft at any normal angle of approach, there should be installed two such beacons at each level. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed heights.

On levels at approximately eight-ninths, seven-ninths, five-ninths, one-third, and one-ninth of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes should be installed on each outside corner of the obstruction at each level.

**Specification "A-10."** When the particular obstruction is more than 1,350 feet but not more than 1,500 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the obstruction and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there should be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach.

At approximately four-fifths, three-fifths, two-fifths, and one-fifth of the overall height of the obstruction, a similar flashing 300-mm

electric code beacon should be installed in such a position within the obstruction proper that the structural members will not impair visibility of this beacon from aircraft at any normal angle of approach. In the event these electric code beacons cannot be installed in a manner to insure unobstructed visibility from aircraft at any normal angle of approach, there should be installed two such beacons at each level. Each beacon should be mounted on the outside of diagonally opposite corners or opposite sides of the obstruction at the prescribed heights.

On levels at approximately nine-tenths, seven-tenths, one-half, three-tenths, and one-tenth of the overall height of the obstruction one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes should be installed on each outside corner of the obstruction at each level.

**Specification "A-11."** Towers and similar obstructions which are more than 1,500 feet in overall heights above ground, or water if so situated, will be given special aeronautical study to determine the proper manner in which to obstruction light them to provide adequate protection for air commerce.

### Trees

A line of trees, with the individual trees located less than 150 feet apart, or a tree covered area should be lighted as an extensive obstruction in the manner set forth in the "E" Specifications for Prominent Buildings and Similar Extensive Obstructions, with the obstruction lights mounted on poles or towers, of a height slightly greater than the height of the outstanding trees. Individual trees and widely spaced trees should be lighted in accordance with the following specifications:

**Specification "B-1."** Poles of a height slightly greater than the height of the outstanding tree(s) should be installed adjacent to the tree(s) and lighted in accordance with the specifications hereinbefore prescribed for individual towers, poles, and similar obstructions of a corresponding overall height above ground, or water if so situated.

### Transmission Lines

The catenary of a transmission line or similar obstructions should be lighted in accordance with the following specifications:

**Specification "C-1."** The towers, poles, or similar structures supporting such a line should be lighted in accordance with the specifications hereinbefore prescribed for individual towers, poles, or similar obstructions of a corresponding overall height above ground, or water if so situated.

**NOTE:** Low-voltage neon-type catenary obstruction lights are acceptable for use as obstruction lights on the conductors of overhead transmission lines having a line current of not less than 100 amperes. This type of light unit is mounted on a single conductor carrying the required current (irrespective of the voltage on that conductor); requires no auxiliary wiring, and collects its energy through a magnetic coupling to the conductor. In view of the fact that the addition of a number of the large model neon catenary obstruction light would increase the tension of the line conductor beyond the supporting tower design, and would in some cases cause the sag of the conductor to violate the clearances prescribed by the Corps of Engineers, Department of the Army, the Federal Aviation Agency will not object to the following manner of installing the large model neon catenary obstruction light on high-tension transmission line crossings or spans: "On three-phase, single-circuit crossings in which the three transmission line conductors are in a flat configuration, each being the same height above the ground or water, install one light on each of the three conductors staggered approximately at the one-quarter points of the overall span. On three-phase, double-circuit crossings in which the phase conductors are in a vertical configuration, install one light on the top conductor of each phase, staggered approximately at the one-third points of the overall span. The small model neon catenary obstruction light, when installed on powerlines, should be spaced insofar as practicable as specified under Specification C-1."

One or more lights, each light consisting of a lamp of at least 100 watts enclosed in an aviation red obstruction light globe, should be displayed for each 150 feet or fraction thereof, of the overall length of the overhead line. These lights should be equally spaced along the entire length of the overhead transmission line at points not more than 150 feet apart and each light should be placed not below the level of the highest wire at the point marked. The distance between the obstruction lights displayed on such overhead wires when located more than 15,000 feet from the reference point of any landing area may be increased to a distance not exceeding 600 feet.

### **Smokestacks and Similar Obstructions**

Smokestacks and similar obstructions should be lighted in accordance with the following specifications:

To avoid the obscurant effect of the deposits generally in evidence from this type of structure, the top lights should be installed from 5 to 10 feet below the highest point of the structure. It is important that these lights be readily accessible to enable cleaning when necessary and to facilitate lamp replacements.

Smokestacks and similar obstructions may be floodlighted by fixed searchlight projectors installed at three or more equidistant points around the base of each obstruction if the searchlight projectors will provide an average illumination of at least 15 candles at the top one-third of the obstruction.

**Specification "D-1."** When the particular obstruction is not more than 150 feet in overall height above ground, or water if so situated:

There should be installed at a near top level of the obstruction three or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least two of the lights from aircraft at any normal angle of approach.

**Specification "D-2."** When the particular obstruction is more than 150 feet but not more than 300 feet in overall height above ground, or water if so situated:

There should be installed at a near top level of the obstruction two or more flashing 300-mm electric code beacons, each beacon equipped with two lamps and aviation red color filters. The two lamps of each beacon should burn simultaneously and each should be at least 500 watts. The beacons should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

At approximately the midpoint of the overall height of the obstruction, there should be installed at least two lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one light from aircraft at any normal angle of approach.

**Specification "D-3."** When the particular obstruction is more than 300 feet but not more than 450 feet in overall height above ground, or water if so situated:

There should be installed at a near top level of the obstruction two or more flashing 300-mm electric code beacons, each beacon equipped with two lamps and aviation red color filters. The two lamps of each beacon should burn simultaneously and each should be at least 500 watts. The beacons should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

On levels at approximately two-thirds and one-third of the overall height of the obstruction, there should be installed on each level at least two lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one light from aircraft at any normal angle of approach.

**Specification "D-4."** When the particular obstruction is more than 450 feet but not more than 600 feet in overall height above ground, or water if so situated:

There should be installed at a near top level of the obstruction two or more flashing 300-mm electric code beacons, each beacon equipped with two lamps and aviation red color filters. The two lamps of each

beacon should burn simultaneously and each should be at least 500 watts. The beacons should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

At approximately one-half of the overall height of the structure, two or more similar flashing 300-mm electric code beacons should be installed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

On levels of approximately three-fourths and one-fourth of the overall height of the structure, there should be installed on each level at least three lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least two lights on each level from aircraft at any normal angle of approach.

**Specification "D-5."** When the particular obstruction is more than 600 feet but not more than 750 feet in overall height above ground, or water if so situated:

There should be installed at a near top level of the obstruction two or more flashing 300-mm electric code beacons, each beacon equipped with two lamps and aviation red color filters. The two lamps of each beacon should burn simultaneously and should be at least 500 watts. The beacons should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

At approximately two-fifths of the overall height of the obstruction, two or more similar flashing 300-mm electric code beacons should be installed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

On levels of approximately four-fifths, three-fifths, and one-fifth of the overall height of the obstruction, there should be installed on each level at least three lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least two lights on each level from aircraft at any normal angle of approach.

**Specification "D-6."** When the particular obstruction is more than 750 feet but not more than 900 feet in overall height above ground, or water if so situated:

There should be installed at a near top level of the obstruction two or more flashing 300-mm electric code beacons, each beacon equipped with two lamps and aviation red color filters. The two lamps of each beacon should burn simultaneously and each should be at least 500

watts. The beacons should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

At approximately two-thirds and at approximately one-third of the overall height of the obstruction two or more similar flashing 300-mm electric code beacons should be installed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least one beacon from aircraft at any normal angle of approach.

On levels of at approximately five-sixths, one-half, and one-sixth of the overall height of the obstruction, there should be installed at least three lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least two lights on each level from aircraft at any normal angle of approach.

**Specification "D-7."** Smokestacks and similar obstructions which are more than 900 feet in overall height above ground, or water if so situated, will be given special aeronautical study to determine the proper manner in which to obstruction-light them to provide adequate protection for air commerce.

### **Prominent Buildings and Similar Extensive Obstructions**

Prominent buildings and similar extensive obstructions should be lighted in accordance with the following specifications. In the event the individual objects of a group of obstructions are approximately the same overall height above ground, or water if so situated, and are located not more than 150 feet apart, the group of obstructions may be considered an extensive obstruction and so lighted.

**Specification "E-1."** When the particular obstruction is not more than 150 feet in overall height above ground, or water if so situated:

If the obstruction is not more than 150 feet in either horizontal dimension, there should be installed at approximately the highest point or edge at each end of the major axis of the obstruction at least one light, consisting of a lamp of at least 100 watts, enclosed in an aviation red obstruction light globe. These lights should be positioned so as to insure unobstructed visibility of them from aircraft at any normal angle of approach, and to indicate the general extent of the obstruction; or, if the shape of the obstruction is such as to make this manner of lighting impracticable, there may be installed two such lights at the approximate center of the highest point or edge of the obstruction. Both lights should burn simultaneously and be so positioned as to insure unobstructed visibility of at least one of the lights from aircraft at any normal angle of approach.

If the obstruction is more than 150 feet in one horizontal dimension, but not more than 150 feet in the other, there should be installed at

least one light, consisting of a lamp of at least 100 watts enclosed in an aviation red obstruction light globe, for each 150 feet, or fraction thereof, of the overall length of the major axis of the obstruction. At least one of these top lights should be installed on the highest point or edge of each end of the obstruction, with the additional lights as required spaced at approximately equal intervals not exceeding 150 feet, on the highest points or edge between the end lights in a manner to indicate the extent of the obstruction and to insure unobstructed visibility of the lights from aircraft at any normal angle of approach. If there are two or more edges of the same height on such an obstruction located near a landing area, the edge nearest the landing area should be lighted.

If the obstruction is more than 150 feet in both horizontal dimensions, there should be installed at least one light, consisting of a lamp of at least 100 watts enclosed in an aviation red obstruction light globe, on the highest point of each corner of the obstruction. In addition, there should be installed at least one similar light for each 150 feet, or fraction thereof, the distance between the corner lights exceeds 150 feet. These additional lights should be installed at approximately equal intervals, at the highest points along the outer edges of the obstruction, between the corner lights in a manner to indicate the general extent and definition of the obstruction and to insure unobstructed visibility of the lights from aircraft at any normal angle of approach.

In the event there are one or more points within the outer edges of the obstruction, the uppermost parts of which are higher than the highest level of the lights hereinbefore prescribed, at least one similar light should be displayed from the top of each such point.

**Specification "E-2."** When the particular obstruction is more than 150 feet in overall height above ground, or water if so situated:

Top lights should be installed on the obstruction in the manner set forth in the applicable provisions of Specification "E-1."

In addition to the required top lights, intermediate lights, each consisting of a lamp of at least 100 watts enclosed in an aviation red obstruction light globe, should be provided for each 150 feet, or fraction thereof, the obstruction exceeds 150 feet in overall height above ground, or water if so situated. The position of these intermediate lights on the vertical plane should be at as close to equidistant levels between the top lights and the ground level as the particular shape and type of obstruction will permit. One such light should be installed at each outside corner of the obstruction at each level and also one such light should be installed at equal intervals on the horizontal plane on each outer surface at each level between adjacent corner lights, for each 150 feet, or fraction thereof, the overall horizontal distance between such adjacent corner lights exceeds 150 feet.

**NOTE:** In lieu of installing the obstruction lights on the obstruction, a pole or poles of a height slightly greater than the overall height of the obstruction may be installed thereto and lighted in accordance with the specifications hereinbefore prescribed for individual towers, poles, or similar obstructions of a corresponding overall height. It is important that those towers, poles, or similar structures be installed in such a manner as to indicate the general definition and extent of the obstruction.

In the event early or special warning is considered necessary to provide adequate protection for aircraft, the top lights on each obstruction as required under Specifications "E-1" and "E-2" should be replaced with one or more flashing 300-mm electric code beacons, each beacon equipped with two lamps and aviation red color filters. The two lamps of each beacon should burn simultaneously and each should be at least 500 watts.

Where obstructions are extensive as in the case of a line of trees or hills, and the use of the fixed obstruction lights would be impracticable or inadequate, flashing or rotating hazard beacons may be used as an alternate to the fixed obstruction lights. Such beacons should be located on the highest points or edges of the extended obstruction at intervals not exceeding 3,000 feet, provided at least three beacons are placed on any one side or edge of the extensive obstruction to indicate a line of lights.

### **Bridges**

The superstructure of a bridge should be lighted in accordance with the following specifications.

Where the bridge structure is over navigable water, approval of the lighting installation must be obtained from the Commandant of the United States Coast Guard to avoid interference with marine navigation.

**Specification "F-1."** When the bridge superstructure is not more than 150 feet in overall length:

There should be installed at the approximate center of the highest point of the superstructure at least two lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. The two lights should burn simultaneously and should be positioned so as to insure unobstructed visibility of at least one of the lights from aircraft at any normal angle of approach.

**Specification "F-2."** When the bridge superstructure is more than 150 feet in overall length:

There should be installed for each 150 feet, or fraction thereof, of the overall length of the bridge superstructure one or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should be installed on the highest points of the superstructure at approximately equal intervals not exceeding 150 feet in a manner to indicate the general definition

and extent of the obstruction, and to insure unobstructed visibility of the lights from aircraft at any normal angle of approach. The distance between these top lights may be increased to a distance not exceeding 600 feet when the particular bridge is located more than 15,000 feet from the reference point of any landing area.

Where the bridge superstructure exceeds 150 feet in overall length and the use of the above described obstruction lights would be impracticable or inadequate, flashing or rotating hazard beacons should be used as an alternate to the fixed obstruction lights. Such beacons should be located on the highest points or edge of the bridge superstructure at intervals not exceeding 3,000 feet, provided at least three beacons are installed to indicate the extent of the obstruction. The flashing or rotating beacons should conform to the provisions of the pertinent specifications as hereinbefore indicated under "Obstruction Lighting Equipment."

### **Water Towers, Grain Elevators, Gas Holders, and Similar Obstructions**

Water towers, grain elevators, gas holders, and similar obstructions should be lighted in accordance with the following specifications.

**Specification "G-1."** When the particular obstruction is not more than 150 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction at least two lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. These lights should burn simultaneously and should be positioned so as to insure unobstructed visibility of at least one of the lights from aircraft at any normal angle of approach.

**Specification "G-2."** When the particular obstruction is more than 150 feet but not more than 300 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. The beacon should be positioned so as to insure unobstructed visibility of it from aircraft at any normal angle of approach.

At the approximate midpoint of the overall height of the obstruction, there should be installed three or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. The position of these intermediate lights on the vertical plane should be as close to an equidistant level between the top beacon and the ground level as the particular shape and type of construction of the obstruction will permit. These lights should be placed at reg-

ular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least two of the lights from aircraft at any normal angle of approach.

**Specification "G-3."** When the particular obstruction is more than 300 feet but not more than 450 feet in overall height above ground, or water if so situated:

There should be installed at the top of the obstruction a flashing 300-mm electric code beacon equipped with two lamps and aviation red color filters. The two lamps of the beacon should burn simultaneously and each should be at least 500 watts. The beacon should be positioned so as to insure unobstructed visibility of it from aircraft at any normal angle of approach.

At approximately two-thirds and one-third of the overall height of the obstruction there should be installed three or more lights, each light consisting of a lamp of at least 100 watts, enclosed in aviation red obstruction light globes. The position of these intermediate lights on the vertical plane should be as close to equidistant positions between the top beacon and the ground level as the particular shape and type of construction of the structure will permit. These lights should be placed at regular intervals on the horizontal plane in a manner to insure unobstructed visibility of at least two lights on each level from aircraft at any normal angle of approach.

### **Group of Structural Hazards**

Towers, poles, tanks, smokestacks, and similar obstructions which are so grouped as to present a common hazard to air navigation should be lighted in accordance with the following specifications.

**Specification "H-1."** This specification applies to a group of closely spaced towers, poles, tanks, smokestacks, or similar obstructions of approximately the same overall height above ground, or water if so situated, in which the spacing between the individual structures does not exceed 150 feet.

The group may be considered an extensive obstruction and lighted in accordance with the "E" Specifications for Prominent Buildings and Similar Extensive Obstructions.

**Specification "H-2."** This specification applies to a group of closely spaced towers, poles, tanks, smokestacks, and similar obstructions, which may or may not be of the same overall height, in which the spacing between the individual structures is not in all cases equal to or less than 150 feet.

Each prominent object within the group should be lighted in accordance with the specifications hereinbefore prescribed for individual towers, poles, and similar obstructions of a corresponding overall height above ground, or water if so situated.

In addition, there should be installed at the top of a prominent center obstruction or on a special tower located near the center of the group of obstructions, at least one rotating beacon producing aviation red flashes. The frequency of its flashes should be such as hereinbefore specified for rotating beacons.

### Hazard Areas

Areas in which a visible or invisible hazard, or hazards, exists should be lighted in accordance with the following specifications.

The obstruction lighting prescribed hereinafter is in addition to such lighting as may be necessary on any natural or manmade obstruction located within the hazard area.

**Specification "I-1."** In an area in which a visible or invisible hazard, or hazards, to aircraft exists:

There should be mounted on top of a tower or other suitable structure, located near the center of the area, at least one rotating beacon producing aviation red flashes. The frequency of its flashes should be such as hereinbefore specified for rotating beacons.

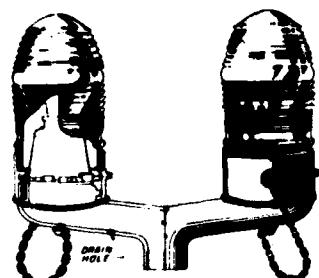
**Specification "I-2."** In a large area in which a visible or invisible hazard, or hazards, to aircraft exists:

There should be installed at two or more places around the perimeter of the area a rotating beacon, mounted on top of a tower or other suitable structure, producing aviation red flashes. The beacons should be located in a manner to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach. The frequency of its flashes should be such as hereinbefore specified for rotating beacons.



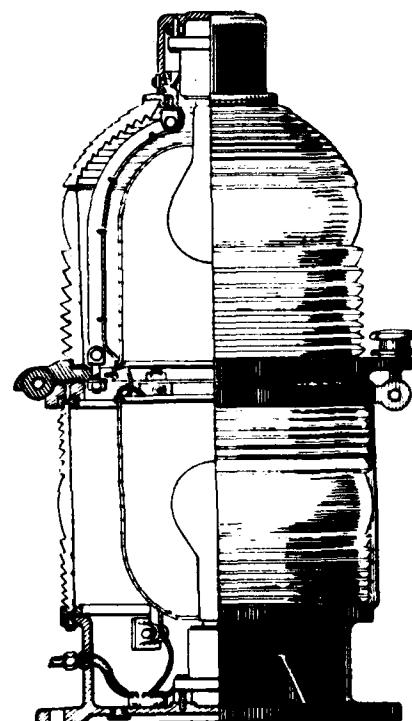
**Single Obstruction**

**Light Fitting**  
**(Fresnel Globe)**

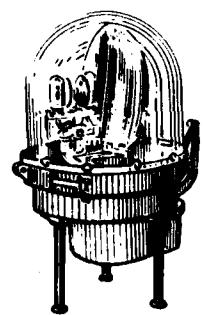


**Double Obstruction**

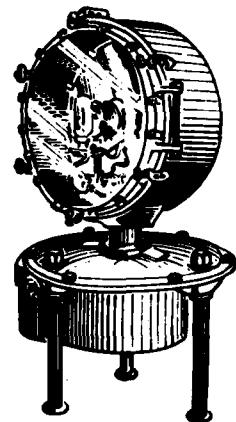
**Light Fitting**  
**(Fresnel Globe)**



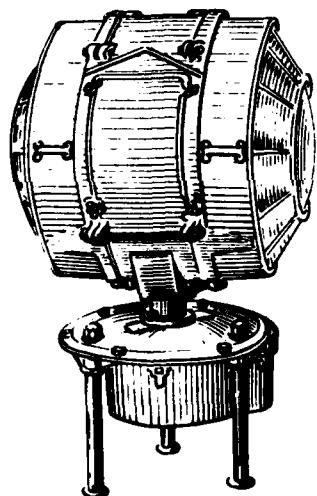
**300 mm Electric Code Beacon**  
**(Fresnel Lens)**



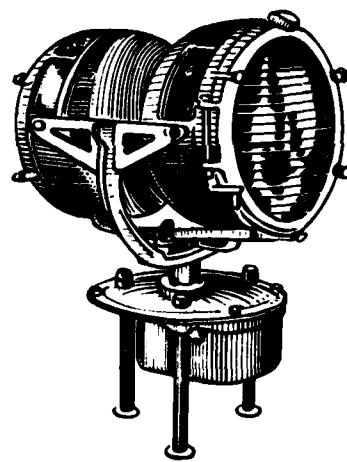
**24-Inch Dome**



**24-Inch Single End**

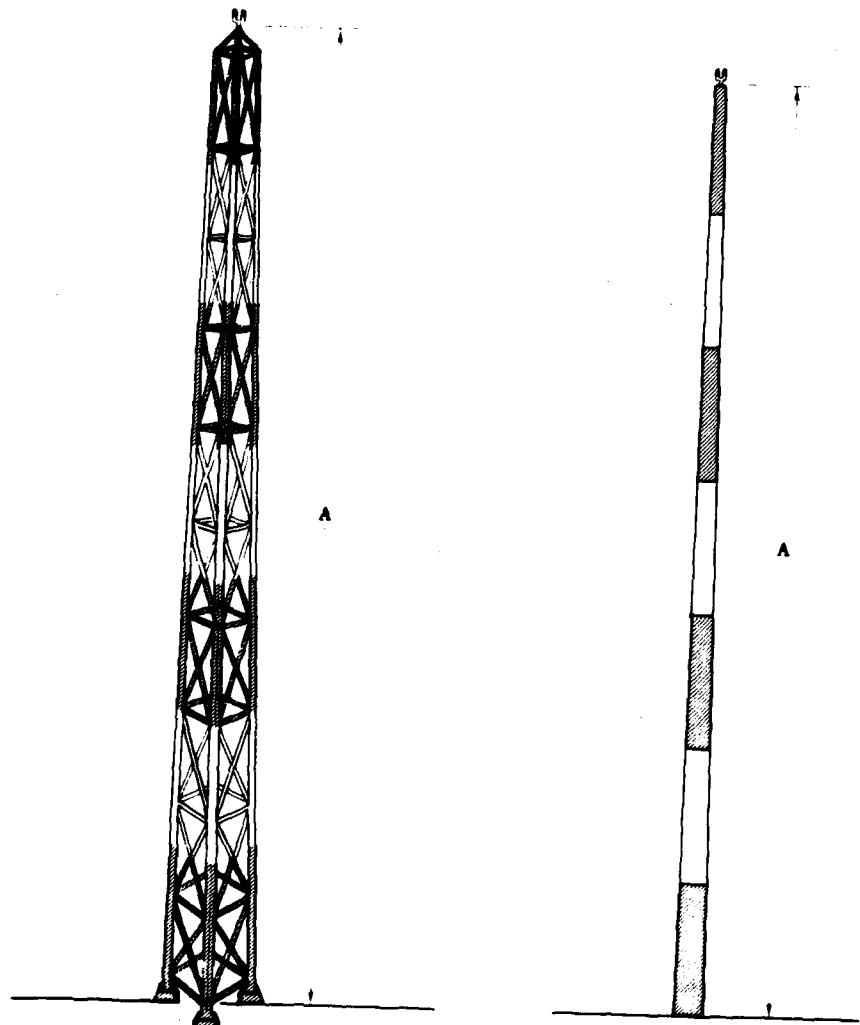


**36-Inch Double End**



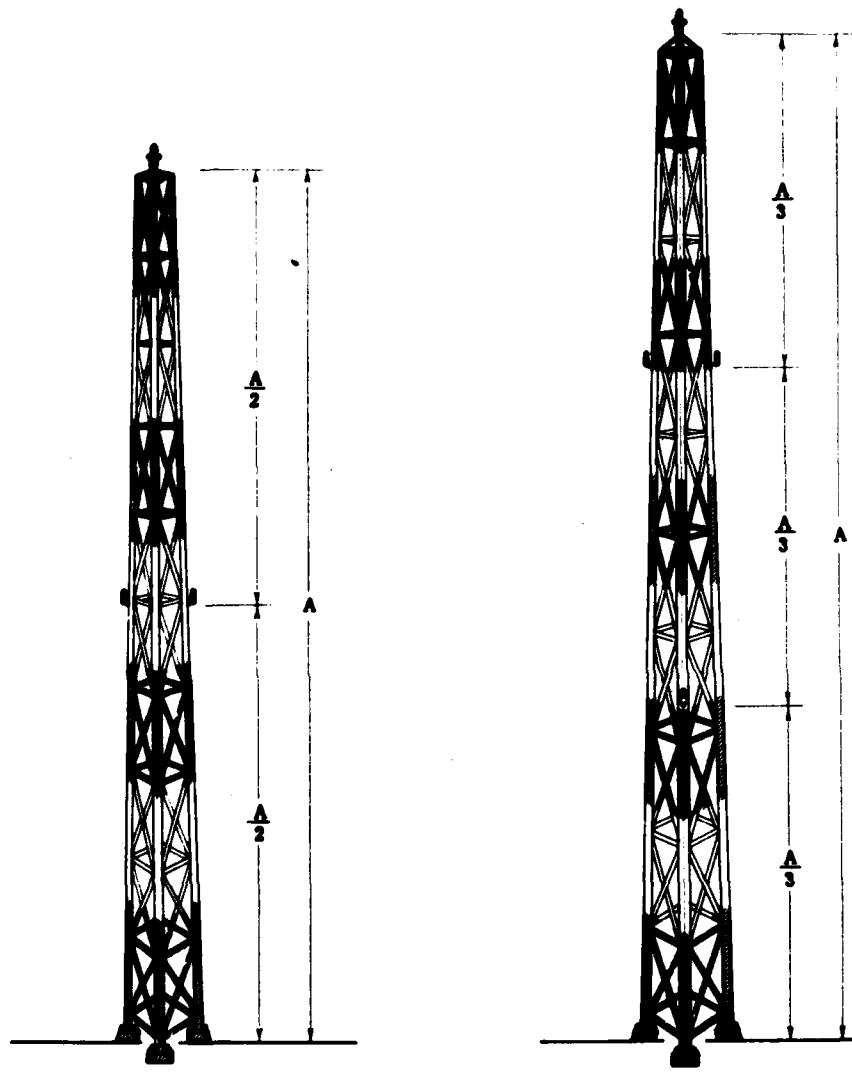
**24-Inch Double End**

### **Rotating Beacons**



A—Not more than 150 ft.

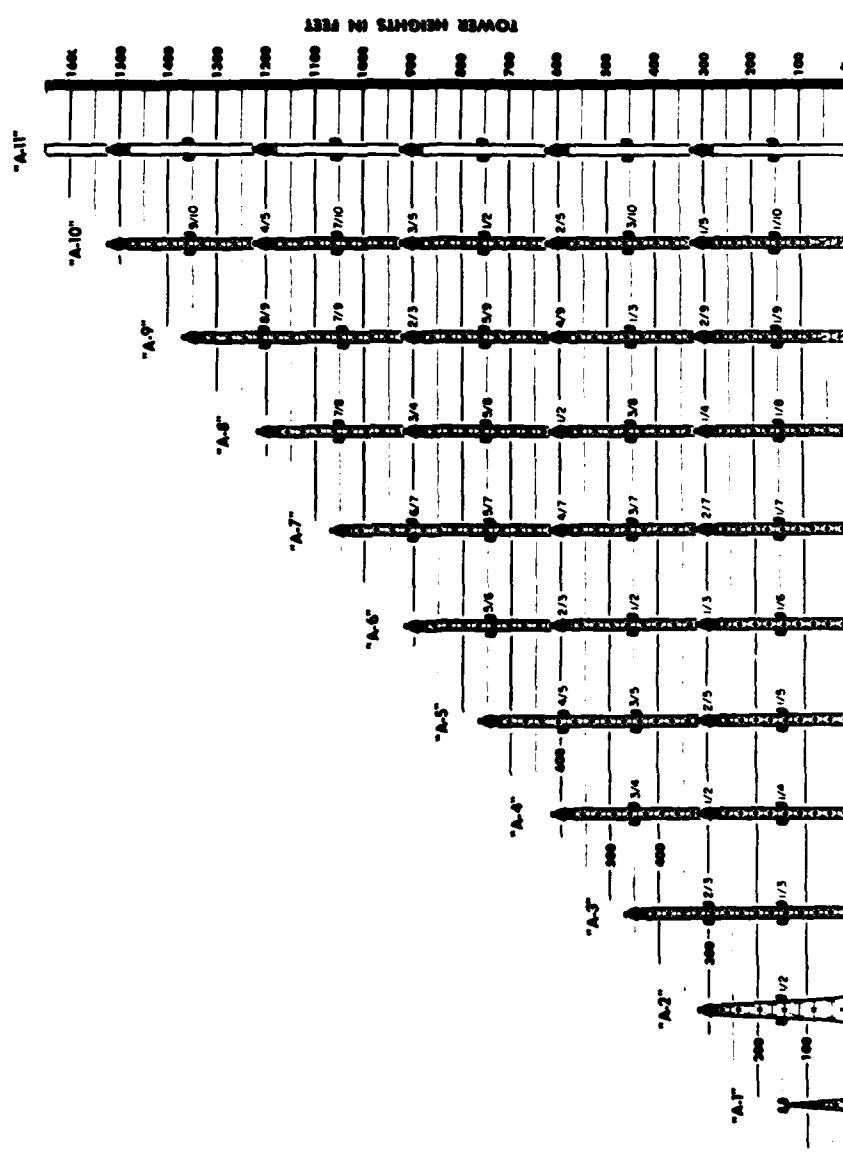
**Painting and Lighting of Towers, Poles and Similar Obstructions**



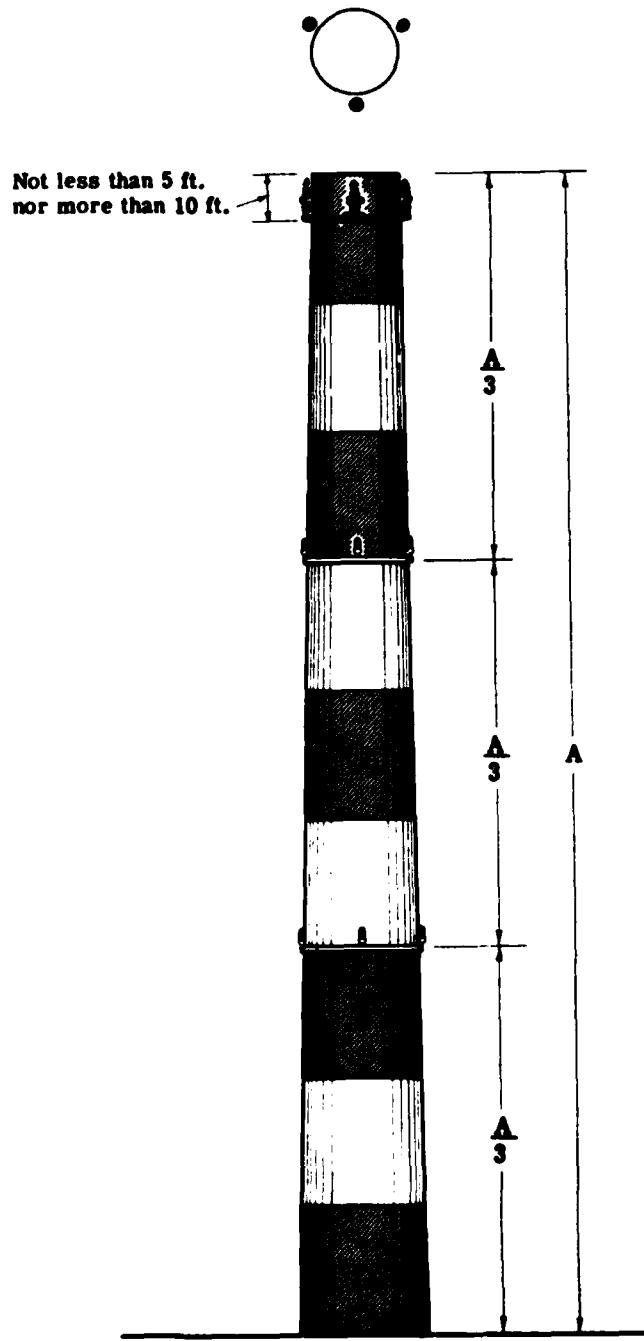
A—More than 150 ft. but  
not more than 300 ft.

A—More than 300 ft. but  
not more than 450 ft.

**Painting and Lighting of Towers and Similar Obstructions**

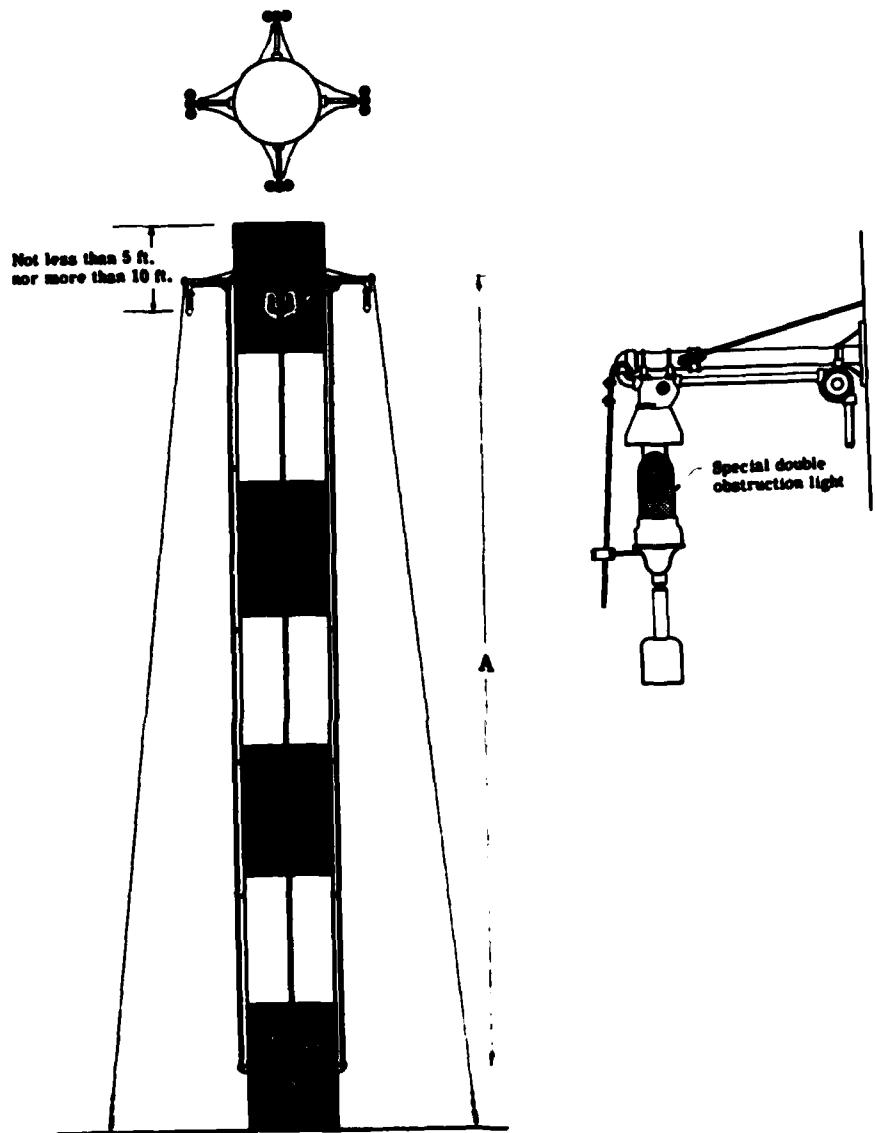


"A" Specifications for Lighting Towers, Poles and Similar Obstructions



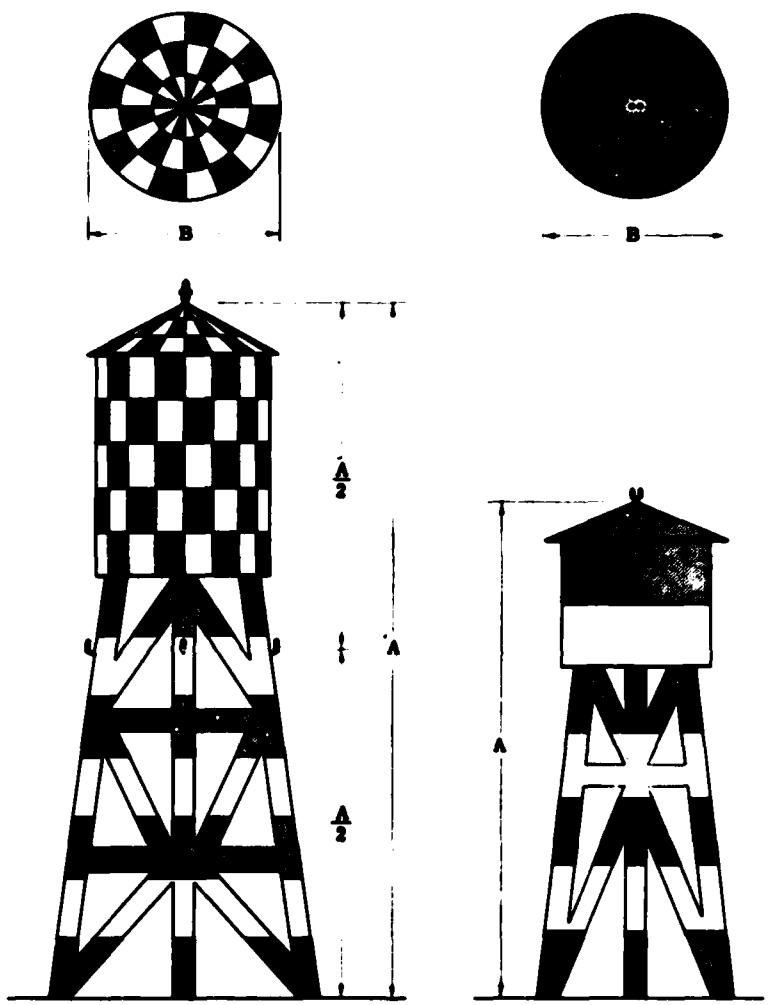
A-More than 300 ft. but not more than 450 ft.

**Painting and Lighting of Smokestacks and Similar Obstructions**



A - Not more than 150 ft.

#### Suspension Type Obstruction Light Installation



**LIGHTING**

A-More than 150 ft. but  
not more than 300 ft.  
B-Not more than 150 ft.

**MARKING**

A and B- 15 ft.  
or more

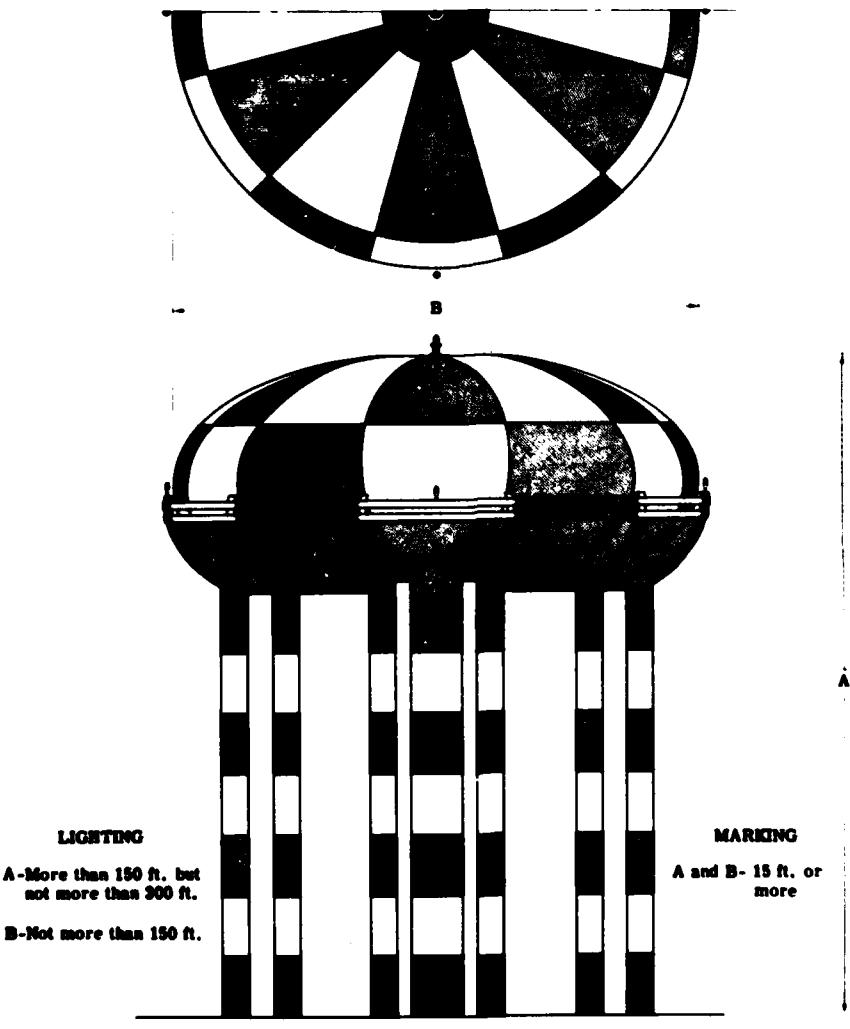
**LIGHTING**

A and B-Not more  
than 150 ft.

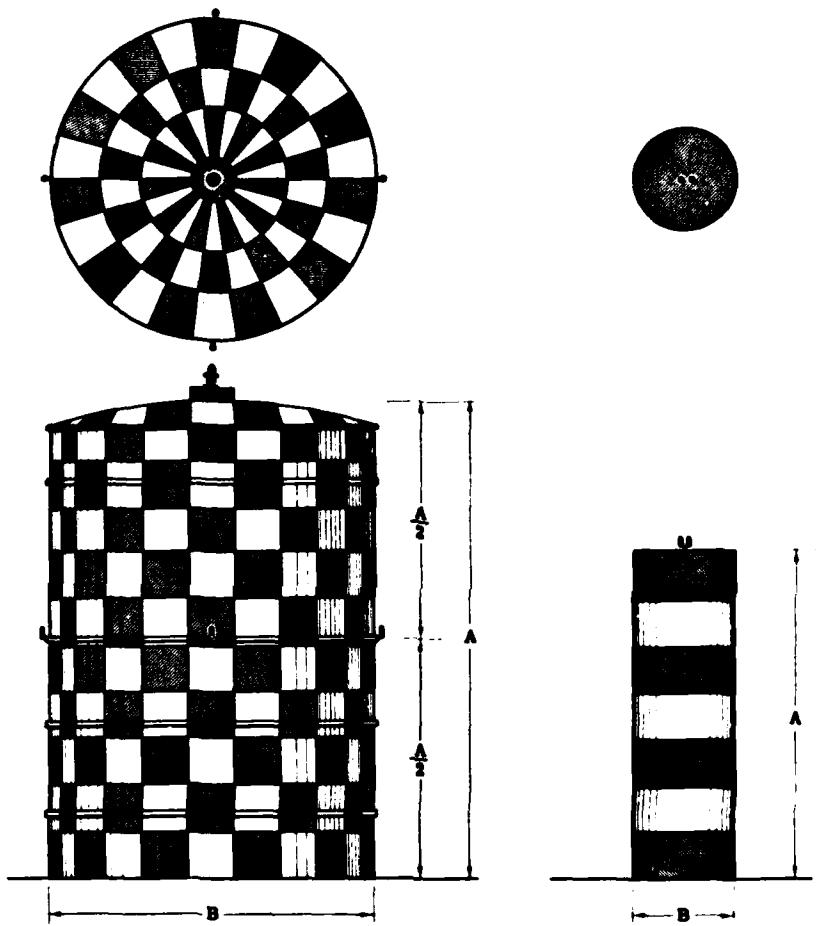
**MARKING**

A-5 ft. or more  
B-Less than 15 ft.

**Painting and Lighting of Water Towers and Similar Obstructions**



**Painting and Lighting of Water Towers and Similar Obstructions**



**LIGHTING**

A-More than 150 ft. but  
not more than 300 ft.  
B-Not more than 150 ft.

**MARKING**

A and B-15 ft. or more

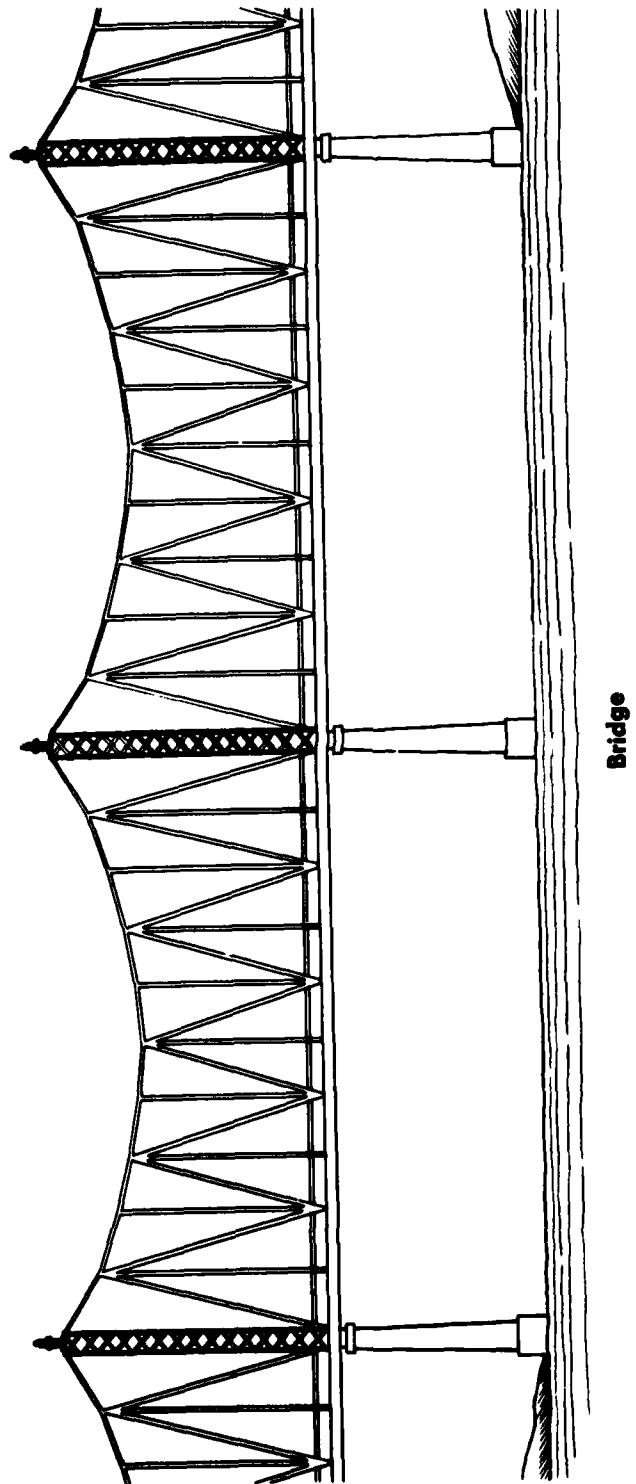
**LIGHTING**

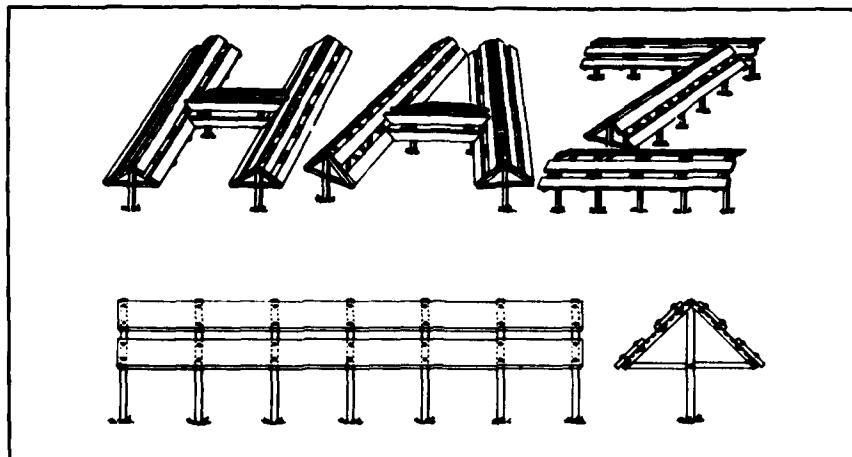
A and B-Not more  
than 150 ft.

**MARKING**

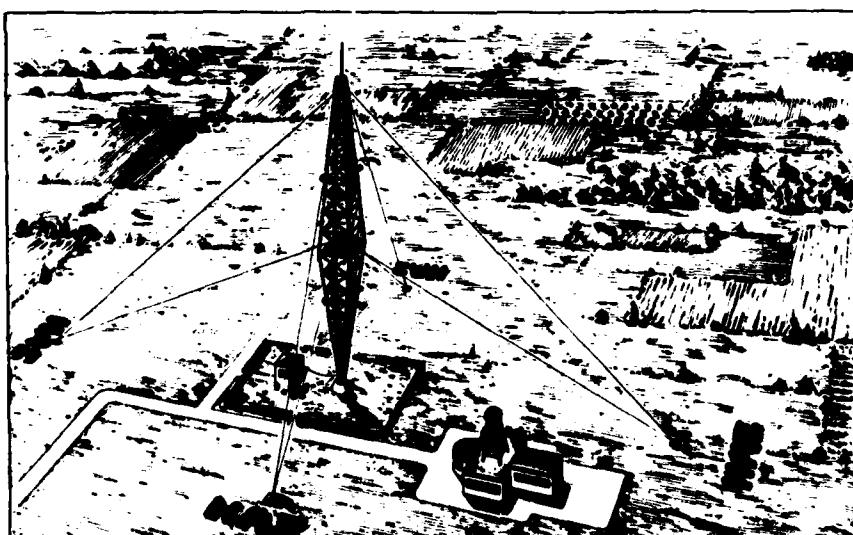
A-5 ft. or more  
B- Less than 15 ft.

**Painting and Lighting of Gas Holders and Similar Obstructions**





Hazard Area Day Marker



Hazard Area Marking